PATENT SPECIFICATION 1,155,236

DRAWINGS ATTACHED.

1,155,236

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Int. Cl.:—H 01 l 1/00.

COMPLETE SPECIFICATION.

Semiconductor Device for the Control of Alternating Current.

We, SOCIETE ANONYME DES ATELIERS DE SECHERON, a Swiss Corporation, of Avenue de Secheron, Geneve, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

To control the two flow directions of an alternating current, two thyristors are placed in antiparallel connection, the two identical but separate construction elements are used.

The disadvantages of this method consist in a complicated assembly and a lack of balance in the characteristics of the thyristors which may result in a direct current component in the alternating current system.

The invention is concerned with semiconductor control devices for alternating current in which there are at least two rectifier elements, at least one of which has a control gate, and which are connected in such a way that at least one of the elements conducts in one direction and at least one other in the opposite direction. According to the invention the rectifier elements of a semiconductor control device of the above type are placed in the same encapsulation and are pressed between two heavy metal pieces which connect the said rectifier elements both thermally and electrically.

The invention thus provides for placing the rectifier elements in the same encapsulation, the result of which is that they are always in the same atmosphere. If the metal pieces used are of large dimensions, good temperature distribution is obtained, that is to say that the temperature of the rectifier elements is practically always the same. This represents a great advantage, because the properties of a semi-conductor element depend very much on its temperature.

[Price 4s. 6d.]

The use of pressure for holding the components together makes allowance for any possible slipping between the layers of the rectifier elements which might be caused by any possible differences in the thermal expansion of the different materials used.

The attached drawings show, as examples, several embodiments of the device according to the invention.

Figure 1 shows two thyristors in antiparallel assembly;

Figure 2 shows a thyristor in antiparallel assembly with a diode;

Figure 3 shows the antiparallel assembly of two thyristors controlled by a single exterior terminal. These drawings all show two thyristors, but the invention may be applied also to rectifier devices in which more than two elements are used.

The two crystals 1 and 11 of Figure 1 have four layers p n p n, anodes 2 and 22 respectively, and cathodes 3 and 33 respectively. The gate electrodes 8 and 88 respectively are connected to the two exterior terminals 10 and 100 respectively by tight inlet insulators.

The encapsulation is composed of two metal pieces 4 and 44 and an insulator 5. It is hermetically sealed or even vacuum tight. The two metal pieces 6 and 66 have very large cross sections and are made from a metal having high thermal conductivity, for example aluminium or copper. The two pieces form a thermal bridge between the two thyristors and they are strongly pressed, by insulated nuts and bolts running in the channels 17 and 18, against the encapsulation and against the two thyristors. These two thermal bridges ensure good temperature distribution between the two thyristors.

To improve the thermal equilibrium, the rectifier elements are brought into the immediate vicinity of one another, which is pos-

sible here because the elements are in the same encapsulation.

Figure 2 shows, as a variation, a thyristor 11 in antiparallel assembly with a diode 1 having three layers p n n+. The thermal bridges 7 and 77 here form part of the encapsulation 4 and 44, thermally connecting the anode of one of the rectifier elements to the cathode of the other. The fact that the combined pieces 7—6 and 77—66 may be made symmetrical so as to make symmetrical thermal paths is an advantage of this type of device. The cooling elements 6 and 66 have ribs which are not shown on the drawing and are cooled by water, oil or air.

In a variant of this embodiment shown in Figure 3, the heavy metal pieces are placed on the inside of the encapsulation. Moreover, the two gate electrodes are electrically connected through small resistors 9 and 99 to a single electrode 10 via a single inlet insulator. Thus is obtained a symmertical semi-conductor device with only one control. The firing of thyristor 1 is effected with the aid of electrode 8 between layers p and n of the cathode side, and by means of electrode 88 between layers p and n of the anode side of thyristor 11. In this way thyristor 1 has its gate electrode at the potential of its cathode and thyristor 11 has its gate electrode at the potential of its anode during the blocking time.

Figure 4 shows another possibility, that of using only one external terminal 10. It is connected to the primary side 12 of a small transformer whose two secondary windings 13 and 14 feed, by resistors 9 and 99 respectively and diodes 15 and 16 respectively, the gate electrodes 8 and 88 respectively. The resistors or the diodes can often be omitted.

In Figure 5, the two large cross section metal pieces form part of the encapsulation and, at the same time, constitute the thermal bridges and cooling elments which are cooled by means of cooling fluid flowing in ribs which are not shown in the drawings. The insulator 5 is made, for example, of synthetic silicone material or material of organic origin. The joint between pieces 5—6—66 is made by known techniques. The electrodes 8 and 88 are connected to the external terminals 10 and 100 respectively by sealed wires crossing insulator 5.

When assembling in parallel or anti-parallel connection three rectifier elements in the same encapsulation, they can be placed at the vertices of a triangle. But when there is a greater number, they can be arranged in a straight line.

The invention can be applied to two different fields. By varying the firing angle of the thyristors, a continuous control for alternating currents can be achieved. Alternatively devices according to the invention can be used as switches for the alternating current, for example, for replacing the metal contacts of inserters of terminals in power transformers. An important advantage of the invention is ensured by the fact that it may utilise for each phase a single element with two power electrodes and a single firing electrode.

WHAT WE CLAIM IS:—

1. Semi-conductor control device for alternating current comprising at least two rectifier elements, one of which at least has a control gate, and which are connected in such a way that at least one of the elements conducts in one direction and at least one other in the opposite direction, and in which these elements are enclosed in the same encapsulation and are pressed between two heavy metal pieces which connect them, on each side, electrically and thermally.

2. Device according to claim 1, in which the heavy metal pieces are placed on the outside of the encapsulation.

3. Device according to claim 1, in which the heavy metal pieces form part of the encapsulation.

4. Device according to claim 1, in which the heavy metal pieces are placed inside the encapsulation.

5. Device according to claim 1, in which connection to the gate electrode or electrodes of the rectifier elements is effected electromagnetically inside the encapsulation by means of a transformer.

6. Device according to claim 1, employing only two rectifier elements in which one of the rectifier elements has its gate electrode at the potential of its anode and the other at the potential of its cathode during the blocking time.

7. Device according to claim 6, in which the gate electrodes are electrically connected inside the encapsulation.

8. Device according to claim 5, in which the connection to the gate electrode or electrodes within the encapsulation includes resistors and/or diodes.

For the Applicants:
GILL, JENNINGS & EVERY,
Chartered Patent Agents,
51—2 Chancery Lane,
London, W.C.2.

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Sheet 1

Fig. 1.

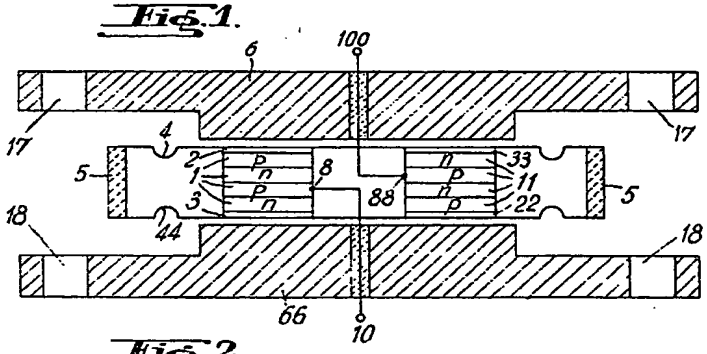

Fig. 2.

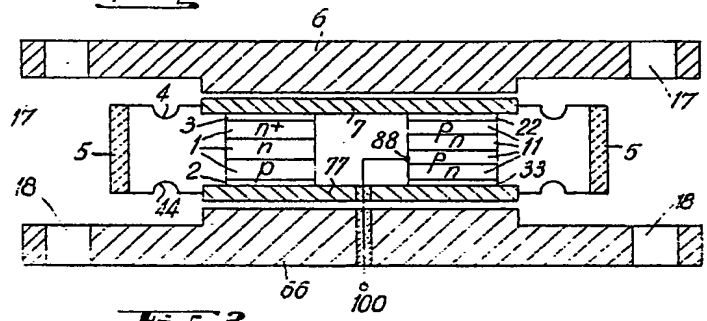

Fig. 3.

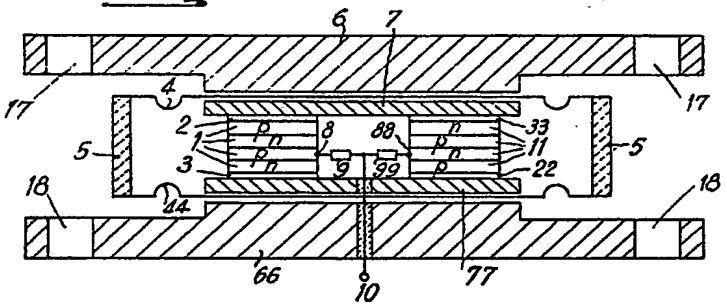

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Fig.4.

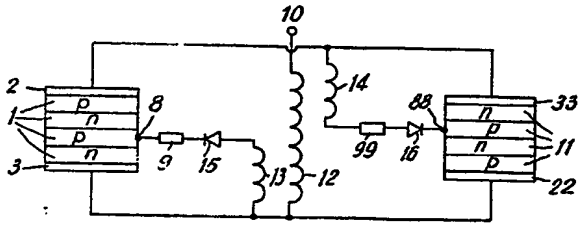
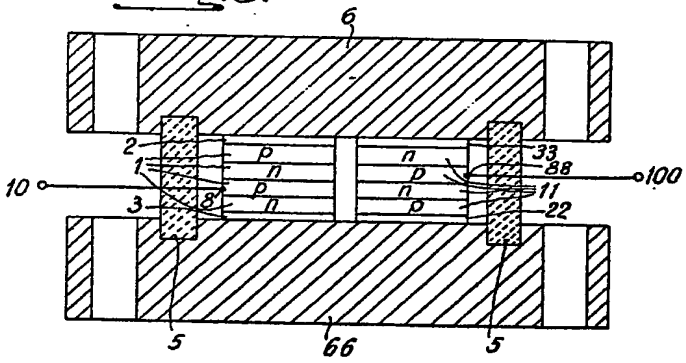


Fig.5.



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Sheet 2

Fig.4.

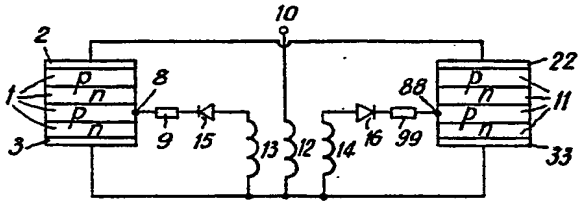

Fig.5.